

Mr. Scudder presented the following paper:—

ON THE GENUS *COLIAS* IN NORTH AMERICA. BY SAMUEL H. SCUDDER.

The determination of the different species of the genus *Colias*, their limits and relations to one another, is one of the most difficult undertakings in the study of the diurnal Lepidoptera, and is rendered by no means less so by the confusion into which they have been thrown by those who have written upon them. Ménétriciés, it seems to me, is almost the only one who has brought to their investigation any considerable degree of acumen or of perseverance. Among the North American species there is as great a degree of confusion as there is anywhere; so that it is necessary for one attempting a fair and impartial investigation into the species on this continent, to entirely separate himself, at the start, from a knowledge of opinions previously expressed in regard to them, if he would not become hopelessly entangled in an intricate web of misconceptions and disagreements. I have had the opportunity of examining a very large number of specimens from the Eastern States and from the Pacific Coast, a considerable number from Labrador and from the central boreal regions, and a few from the States bordering the Mississippi River. The collections which I have used have been those of the Museum of Comparative Zoölogy, Cambridge; the very beautiful series of Mr. W. H. Edwards, at Newburgh, N. Y.; the collection of butterflies of the Lyceum of Natural History, Williams College, Mass., and my own specimens, which are mainly from New England.

In treating of the genus *Colias* in North America, we should first of all separate from them *C. Coesonia* Stoll and *C. Wosnesenski* Mén.; of which latter, according to Edwards, in Morris's Synopsis, *C. Eurydice* Boisd. is a synonyme,—these must be placed in the genus *Zerene* Hübner.

Of the number of species found south of the northern boundary of the United States, I cannot form any settled opinion, nor can I of their range; for, though I have seen a very large number of specimens, these have been limited mostly to the extreme eastern and western borders of our country; yet I have very strong doubts whether there are anywhere more than two species, *C. Philodice* Godt. and *C. Eurytheme* Boisd.,—the former an Eastern species, but found so far west as Missouri; the latter a Western, but found so far east as the Mississippi, and perhaps even to the Atlantic border, south of New York. The former is the only sulphur-yellow *Colias* I am acquainted with in the United States, the latter the only orange-tinted species I know of within its borders. To *C. Philodice*

belong, I think, specimens in the Museum of Comparative Zoölogy, from Osage River, Missouri, which are very large, — males and females alike measuring two and one-half inches in expanse of wings, and having the under surface of secondaries pure yellow, without any dusky scales. Here, also, belongs a pair of specimens, taken *in coitû*, in Illinois, in Mr. Edwards's collection, — the male of which has the wings yellow, but plainly tinged with orange on the disc; the only specimen of *C. Philodice* which I have seen with any orange tint upon it.

To this species, also, must be referred all the species indicated by Fitch in the 13th vol. of the Transactions New York State Agricultural Society, as *Chrysothème* var. A, *Phicomone*, *Nastes* and *Santes*, — the three former of which are not the species so named by European authors, and the last of which is named only from a dwarfed specimen of *C. Philodice*, equally small individuals of which I have seen in Mr. Edwards's collection. It should also be added here that Dr. Fitch leads us into an error when he states that they may all doubtless be considered as but "varieties of two species, the *Philodice* and *Phicomone* of Godart, — the latter having a row of yellow spots in the black border of the upper wings in both sexes, whilst the former has these spots in the females only;" for we have no species here having a row of yellow spots in the marginal border of the males, and so at all referable to *Phicomone*.

It would seem as if the genus *Colias* might properly be divided into three sections: —

1°. Those having a glandular space at the base of the secondaries in the males.

2°. Those wanting this space, and having the two sexes of the same color.

3°. Those wanting this space, with the sexes of different colors.

Of the first section, none have been found in North America. To the third seem to belong all and only the boreal species.

There are two kinds of females of *C. Philodice*. One, by far the most common, is of the same yellow color as the male, or very nearly the same; the other is whitish, about the tint of *C. Hyale*, or even much paler. I have seen some considerable variation in the depth of tint in both, but never any specimens through which a gradation could be shown from one to the other, — they are either of one tint or the other, — nor have I seen this albinism ever exhibited in the males. This does not leave us in doubt that *C. Philodice* should be placed in the second section, for the white females are of great rarity.

I have examined a large number of specimens from California and Washington Territory, obtained by Mr. Agassiz, which

answer exactly to the description given by Boisduval of *C. Eurytheme* and *C. Amphidusa*, and I consider them to be the same species, for which the name of *Eurytheme* must be retained; the only difference between the two which acquires any degree of constancy is the depth and breadth of the orange tint upon the upper surface, which, in the specimens that correspond to his *Amphidusa*, covers the whole wing not occupied by the black border; while, in those corresponding to his *Eurytheme*, it covers only a central portion, and is not so deep, being mixed more with yellow; but this depth and extent of the tint appears also to be a variable character, and not to separate into two well-marked groups these Western individuals. I have seen specimens from Minnesota, Lake Superior and Texas, which seem to correspond entirely to those of the Pacific Coast. Mr. Edwards first brought to my attention the fact that the upper surface of this species has a purplish lustre when seen by oblique light, especially in those from California and Texas. This is undoubtedly the species referred to by various authors in stating that *C. Edusa* and *C. Chrysotheme* were found in California, and I suspect its prevalence even to the Atlantic border, south of New York, because it has also been asserted by authors that the two species just mentioned had been found there. I have not seen any specimens from the Middle States which could have been mistaken for them, and so cannot speak with any certainty.

Boisduval mentions, in his description of *C. Amphidusa*, that the only female he had seen was pale. There are no albinic specimens among the females I have seen; but if they occur, it only agrees, in this respect, with other allied species. Morris, in his Synopsis, gives Boisduval's authority for the localization of *C. Hyale* in California. I do not know where Boisduval asserts this, unless it be in the 3d Series of the Annales de la Société Entomologique de France, which I have not seen, but if he does, it may have been a mistaken reference of this albinic female of *C. Eurytheme* to that species.

There are three species of *Colias* in boreal America, — *C. labradorensis*, *C. interior* and *C. occidentalis*, — described below. The first inhabits Labrador, the second the interior of the continent, and the third the western portion, including the Rocky Mountain region. They are all closely allied to one another and to *C. Pelidne*, Boisd. and Lec. They do not, any one of them, agree with the figures and descriptions given of *C. Pelidne*, — under which name, I suspect, more than one species is confounded. Boisduval, in his first description of *C. Pelidne*, in Boisduval and Leconte's Histoire générale des Lépidoptères de l'Amérique Septen-

trionale, states it to be found in Greenland, Iceland and Labrador, and I presume his figure to have been taken from, and his species referable to, the species found in the former localities. The male of *C. Pelidne*, as figured by Boisduval in his *Icones historique des Lépidoptères*, is much like the male of *C. interior*; while the figures given by Herrich Schæffer (which I cannot think, with Ménétriés, were copied from Godart) closely resemble *C. labradorensis*, if they are not of the same species, though the species described as *Pelidne* by Ménétriés, on page 84 of his *St. Petersburg Catalogue*, does not seem to be the same as *C. labradorensis*. "Lederer," says Ménétriés, "pretends that he knows *Pelidne* only from Labrador." I think it must be that the true *C. Pelidne* is not found in Labrador, and that my *C. labradorensis*, which cannot be referred to it, is the species seen by Lederer, and hitherto undescribed. Other species, known in boreal Europe, have also been stated to have been found in boreal America, but I suspect that, in all these cases, a close resemblance has been mistaken for an identity. Of the two Arctic species, I know nothing, but none of the species I here describe are the *C. Boothii* or the *C. Chione* of Curtis, described in the Appendix to Ross's Second Voyage.

There seem to be three distinct faunæ in boreal America, in each of which the genus *Colias* is represented by a distinct species; so far as is simply indicated by an examination of the species of diurnal Lepidoptera which I have seen from there, the easternmost is confined to a narrow limit, comprising only the eastern portion of Labrador; the central appears to include in general all the country watered by streams flowing into Hudson's Bay, whether upon its eastern, western or southern coast; and the westernmost includes the Rocky Mountain region, and the country west of it. These faunæ are very closely related to one another, being connected most intimately by true representative species; they are connected together more intimately than any of them are to the faunæ lying immediately south, — in the north temperate region the relationship between these two sets of faunæ being shown rather by what may be termed *equivalent* species, as, for instance, *C. Philodice*, in comparison with *C. labradorensis* or *C. interior*; for there may be said to be three sorts of species, which may be designated thus:—

1°. *Representative species*, or those forms occupying different geographical areas, which exhibit an intimate homology in their specific peculiarities, such as the three species of *Colias* here described in comparison with one another.

2°. *Equivalent species*, or those forms occupying different geographical areas, which do not exhibit such an intimate homology in their specific peculiarities, but simply represent the genus in the faunæ



in which they are located, without any such peculiar reference to the species of the same genus in other faunæ, and so may also be well termed *species of replacement*. It will thus be seen that any given species may be a representative species when compared with one, and an equivalent species when compared with another specific form.

3°. *Complemental species*, or those generically allied forms which occupy the same geographical area, where, if I may so express it, the *specific material* belonging to any one zoölogical fauna has been given expression through more than one specific form. Examples have been given sufficient to illustrate my meaning in regard to the first two classes; of the third, good examples will be found in *Pieris Rapæ* and *Napæ* of Europe, which, in reference to one another, are complementary species, while both together are representatives of our *Pieris oleracea*.

I place here three cuts exhibiting the marginal bands of the three boreal American species of *Colias*, after the example of Ménétriés in his catalogue, with descriptions appended.



*C. occidentalis.*



*C. interior.*



*C. labradorensis.*

#### COLIAS LABRADORENSIS (nov. sp.)

♂. Above, *primaries* lemon-yellow with a slight greenish tinge, brighter than in *C. Hyale*, much as in *C. Palæno*; marginal band broad, black, dusted with yellowish scales; the inner border irregularly crenulated, parallel with the outer border, except near the costal border, where with a full curve it is turned inward a little; there is also a slight turning in of the border just below the sub-median nervure; the fringe is of moderate width; there are crowded black scales occupying a small space at the lower portion of the base of the wing; — *secondaries* much the same color as the primaries, but having a very slightly more greenish tinge; the outer black band extends from midway between the termination of the costal and upper branch of the sub-costal nervures to midway between the termination of the sub-median and lower branch of the median nervures, sometimes reaching the former; the band is of moderate breadth, with the inner border quite regularly curved, sometimes slightly scalloped; the base has many black scales, giving a grimy appearance, not extending over a wide space, but chiefly attaching to the median nervure.

Below, *primaries* of the same yellow as the superior surface, but somewhat griseous, through the presence of scattered black scales over the apical half, abundant along the costal edge; the inner border is free of them, and of a paler yellow; the costa is of the same pink as the fringe, and the spot at the extremity of the cell is transverse, black, with a pink or yellow conspicuous centre;—*secondaries*, greenish-yellow, griseous, with black scales, which are less numerous, in a faint, broad band along the outer margin, which is thus of a slightly lighter tint; the fringe of pink extends around the costal border as a narrow edging; there is generally a slight cluster of reddish-brown scales just beneath the extremity of the costal nervure; the spot at the tip of the cell is small, circular, of pink scales, deepening in tint from the centre, — where there are mixed a few white scales, — so that the edge is sometimes brownish; it is almost invariably single, but occasionally with a secondary one towards the outer angle of the wing; there is a small spot of pink scales at the base of the wings.

♀. Above, *primaries* very pale dirty white, with a slight greenish-yellow tinge; costal border somewhat griseous, with dark scales; the apex is occupied by a dark brownish spot, having the inner border ill-defined, sometimes so large as to extend half way to the termination of the cell, and reaching the internal angle as a narrow band; when it is large there are several streaks of the color of the disc towards its inner border, placed between the nervures, generally broadest toward the base, and acuminate toward the inner border; the spot at the extremity of the cell is faint or absent, a little transverse, brownish, with a pale centre; the costal edge is pink, as is also the rather narrow fringe; — *secondaries*, of the color of the disc of primaries, but with more of a greenish tinge, with a very faint broad border wanting it; a few blackish scales cluster around the tips of the nervures at the outer angle, where the pink fringe is interrupted paler by bands.

Below, *primaries* as in the male, except in having the yellow replaced by a very pale greenish-white, save at the tip, where there is a spot of yellow; — *secondaries* as in the male; head, antennæ, and palpi above, pink; palpi below, yellow; lower side of club of antennæ, yellowish; legs pink; expanse of wings, two inches. 8 ♂, 5 ♀. Caribou Island, Straits of Belle Isle, Labrador. (A. S. Packard, Jr.)

#### COLIAS INTERIOR (nov. sp.)

♂. Above, *primaries* lemon-yellow, as in *C. labradorensis*, but lacking the greenish tinge, and so of a brighter tint, much as in the male of *C. philodice*; costal edge dark pink; marginal band black, narrow, except at tip; the inner border of band with a deep curve, extending along costal border to the tip of the costal nervure, not extending far inward along the inner border, the deepest portion

of the curve and the narrowest of the band being where the third branch of the median nervure strikes it, and so placed much farther down than in *C. labradorensis* or *C. Philodice* or *C. occidentalis*; the spot at the extremity of the cell is generally wanting, but when present is an indistinct transverse spot of grayish scales, with a yellowish centre; there are a very few grayish scales clustered at the base of the wings; the fringe is pink;—*secondaries* of the color of the primaries, with the marginal band narrow, not crenulated interiorly, extending from the second (or between the first and second) branch of the median to just beyond the first branch of the subcostal nervure; discal spot small, circular, pale orange, with a faint dusky border; fringe pink, pale towards the outer angle.

Beneath, of a more sulphur-yellow, with scattered grayish scales; the costal border of both wings narrowly edged with pink; the discal spot of primaries as above, but distinct; discal spot of secondaries not small, circular, the centre composed of silvery and pale pink scales mingled, with the border composed of reddish-brown scales; fringe pink.

♀. Above, white, with a very pale yellowish tinge; costal border with a few griseous scales joining a dusky spot at tip, which has the inner border illy defined, but extends with a curve around the outer border rather more than half way down to the inner angle, as in some specimens of *C. labradorensis*; the discal spot is as in the male, and indistinct; the secondaries are immaculate, save the faint discal spot as in the male.

Beneath. The only specimen I have is somewhat rubbed, but appears not to differ from the male, except in being pale instead of yellow.

Head, etc., as in *C. labradorensis*, except the under surface of the club of the antennæ, which is yellowish-brown.

Expanse of wings, ♂ 2.1 in.; ♀ 2 in. 5 ♂, 1 ♀. Northern shore of Lake Superior (Prof. Agassiz); mouth of the Saskatchewan River, British America. (S. H. Scudder.)

#### COLIAS OCCIDENTALIS (nov. sp.)

♂. Above, *primaries* color of *C. philodice*; the marginal band quite broad; the inner border curved much as in *C. labradorensis*, commencing at a point a little inside the termination of the costal nervure, and extending inwards along the internal border rather more than in *C. labradorensis*, parallel to the border from the upper median nervule to the sub-median nervure; a few distant grayish scales are scattered along the costal border, scarcely affecting the general tint; they are clustered profusely at the base, but extend over only a narrow space; the discal spot is small, oval,

transverse, sometimes quite faint; fringe pink; — *secondaries* same color as primaries, with grayish scales scattered over nearly the whole wing, more profuse at the base; the marginal border is very nearly as broad as that of the primaries; the inner border only slightly curved, extending from the tip of the costal nervure to the second median nervule, with a spot between the first and second median nervules; discal spot as in the males of *C. interior*; fringe pink, paler toward outer angle.

Beneath, *primaries* same color as above, with the costal border somewhat griseous with grayish scales, and the apex of a slightly deeper sulphur-yellow; — *secondaries* sulphur-yellow, with black or grayish scales scattered rather profusely over the whole wing, least abundant toward the outer border; there is a small spot of pink scales at the base, and a small, faint spot of ferruginous scales just below the tip of the costal nervure; there are three faint dots of brownish scales, scarcely perceptible, on each, near the middle of the space between the sub-median and the first branch of the median, the first and second and second and third branches of the median nervures; the discal spot is much as in *C. interior*.

♀. Above, *primaries* white, with a very pale greenish tinge; costal border broadly margined with closely-clustered grayish scales; a very broad, dusky margin to the external border, which has along its middle line a series of large, ill-defined, whitish spots, as in the females of *C. Eurytheme* Bois.; the base has a broad spot of much scattered grayish scales, more closely associated toward the internal border; the discal spot is large, rounded, of grayish scales, with a small whitish centre; — *secondaries* like the primaries, with a slightly deeper greenish tint; the outer marginal band broad, extending with equal breadth nearly to the internal border, but nearly obliterated by the row of large white spots occupying so much of its space; grayish scales scattered over the whole disc, closely clustered between the median and sub-median nervures, especially toward the base; the discal spot is large, circular, pale orange; the fringe of both wings is pale pink.

Beneath, *primaries* of the same general tint as the upper surface, with scattered gray scales along the costal border, and across the wing along a line corresponding with the inner border of the band on the upper surface, clustered between the nervures into more or less distinct and larger or smaller spots; the apical portion is pale yellowish; — *secondaries* very pale sulphur-yellow, with indistinct grayish scales, rather distant, but more abundant toward the basal half of the disc; discal spot as in the female of *C. interior*; there is a faint spot by the tip of the costal nervure, as in the male, and a row of indistinct brownish dots parallel to, and distant from, the hind



border, between the nervules, as in the males, but rather larger, more distinct, and numerous.

The primaries of the females are noticeably more pointed, and their outer border straighter than those of the males.

Antennæ dark brown above, reddish brown below; legs and collar pale pink; expanse of wings, ♂ 2.1 in.; ♀ 2.4 in. 2 ♂, 3 ♀. Gulf of Georgia (A. Agassiz); Fort Simpson, British America. (W. H. Edwards.)

The President announced the completion of the subscription, in aid of the Society, to the required amount of \$20,000, and stated that the \$20,000 promised on this condition, by a gentleman in this vicinity, had been placed in the hands of the Treasurer.

Prof. Wm. B. Rogers congratulated the Society upon this large accession to its means of usefulness, and offered the following resolutions:—

*Resolved*, That the donation of \$20,000, this day presented to the Society, through the President, by Dr. Wm. J. Walker, be hereby accepted, to be appropriated in such manner as may conform to the wishes and suggestions of the donor.

*Resolved*, That the Society hereby tender to Dr. Walker their most grateful acknowledgments for this renewed and munificent proof of his interest in their prosperity, and for the occasion and the incentive which it has afforded to other friends of the Society to contribute an equal aggregate amount.

*Resolved*, That, in view of this and the previous benefactions by which Dr. Walker has marked his appreciation of our scientific labors and aspirations, we feel that to his liberality, chiefly, we are indebted for the enlarged opportunities of usefulness now so brightly opening before us, and that, in offering him the homage of our grateful hearts, we have no need to assure him of the enduring honor which will associate his name with the future successes and the whole history of the Society.

The resolutions were seconded by Rev. Mr. Waterston, and adopted unanimously.

Prof. Rogers proposed in addition the following resolutions, which were passed:—

*Resolved*, That the Society is deeply grateful to the kind patrons who, amid the urgent public claims on their liberality, have contributed towards the erection of our new building an aggregate sum